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External Biliary Bypass with a Bile Pumping Reservoir

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The prognosis after curative or palliative operations for malignant lesions causing obstructive jaundice is still dismal. In some cases, senility or complications make surgical intervention not feasible even for palliation.

For those inoperative malignancies causing extrahepatic cholestasis, percutaneous trans-hepatic drainage offers a safe alternative. Prolonged palliation with external drainage, internal/external drainage and internal drainage with endoprosthesis have been reported^{1,2,6,7,9,10,11,13},

Those patients for whom all types of effective internal drainage are impossible must carry a permanent indwelling external drainage tube and a bile collecting bottle. On the other hand, it is advantageous for the outflowing bile to be returned to the intestinal tract to aid in the absorption of lipids and to prevent the loss of body fluid and electrolytes. For that purpose the oral intake of bitter bile or the administration of it through a nasogastric tube is inevitable. Both of these methods are quite unpleasant, and these patients are usually dejected and will not lead active lives, especially as they must always carry a bile collecting bottle.

The authors tried to return externally drained bile into the jejunum by connecting the PTCD-tube or T-tube with a catheter inserted into the jejunum with a bile reservoir with one-way valves at each end. This method was used in three patients and the result was reasonably satisfactory.

Material and Methods

Between February 1982 and October 1983, we treated three patients with external biliary bypass. They were all jaundiced with unresectable tumors, two males with cancer of the head of the pancreas and a female with cholangiocarcinoma at the porta hepatis (Table 1). Internal biliary drainage could not be established either surgically or with PTCD in any of these patients.

During the prolonged period of external biliary drainage with PTCD, Case 1 refused both the oral intake of bile and the insertion of a nasogastric tube. Since she produced about 1000 ml of bile a day, we made a catheter jejunostomy under epidural anesthesia in order to return the bile. Thus both PTCD and jejunostomy provided data for us to devise a system for her convenience.

The external biliary bypass was composed of the external biliary drainage tube, the

Key words: Malignant extrahepatic cholestasis, Palliation, External biliary bypass, PTCD, Bile pumping reservoir.

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Table 1. Cases treated with external biliary bypass

	Case 1	Case 2	Case 3
Age and Sex	81 F	78 M	72 M
Diagnosis	Cholangiocarcinoma Asthma	Pancreatic Cancer Gastric Cancer	Pancreatic Cancer Multiple Myeloma
Surgical Intervention	PTCD Jejunostomy	T-tube insertion Jejunostomy	PTCD, Jejunostomy T-tube insertion Gastrojejunostomy
Drainage	PTCD	T-tube	T-tube
Duration of Drainage	12 months	9 months	13 months
Duration of Ext. Bypass	4 months	4 months	12 months
Bil. (mg/dl) Pre-Post	9.0-1.0	29.4-1.0	19.0-1.0
Contamination	Klebsiella	Pseudomonas	Enterobacter

jejunostomy and the bile pumping reservoir interposed between them with one-way valves at both ends (Fig. 1).

The valve is made of two sheets of thin film in layers, sealed on its sides. The valve itself is 35 mm long with its open end at the proximal hepatic side and covered within the valve chamber. Minimal normograde pressure gradient opens the space between the films and permits normograde bile flow, whereas minimal retrograde pressure gradient collapses the space and retrograde flow of bile is blocked. Its structure is that of a Heimlich valve except for its size and material. A reservoir interposed between these valves has a 20 ml capacity and is elastic so that it can easily be compressed manually in order to expell the reservoired bile into the jejunum and that meantime it expands spontaneously in order to aspirate bile from the proximal biliary tree (Fig. 2).

In order to assure the effectiveness of the valves, we monitored for 24 hours the common bile

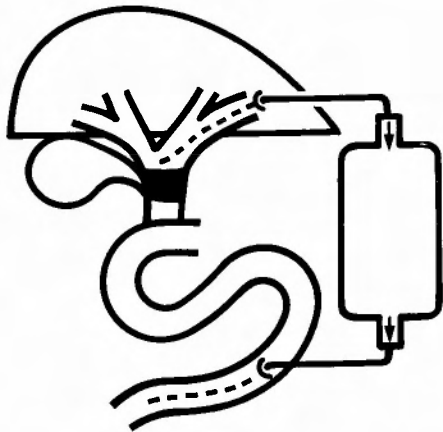


Fig. 1. A schematic drawing of the external biliary bypass composed of external biliary drainage, the reservoir and a catheter jejunostomy.

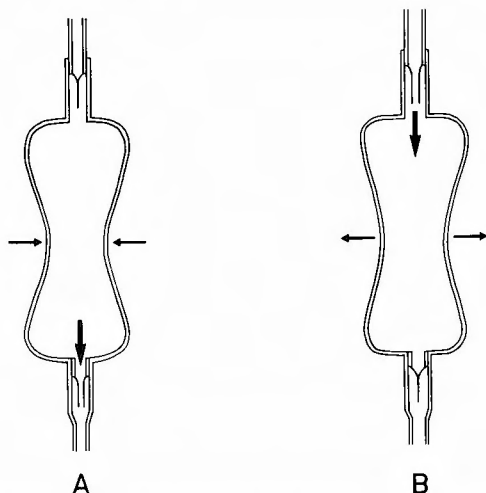


Fig. 2. A, when the reservoir is compressed, bile is forced into the jejunum while the proximal valve blocks the conduction of pressure rise to the biliary system. B, when it is freed to expand, bile is pumped into it whereas the distal valve closes and prevents the inflow of jejunal content.

duct, duodenal and jejunal pressures under different conditions. The indwelling catheter was perfused with saline 0.05 ml/min and was clamped to equilibrate the line for 40 seconds before the pressure was read as the height from the anterior axillarline. The pressure was measured every 5 minutes.

Results

(1) The resting CBD pressure was between 7 and 16 cm H₂O, (2) When the patients were eating, CBD pressure was between 0 and 20 cm H₂O with a functioning sphincter of Oddi, and intraduodenal pressure fluctuated between 0 and 50 cm H₂O. (3) After choledochoduodenostomy, CBD pressure was directly influenced by the intraduodenal pressure. (4) The jejunal pressure during meals fluctuated between 0 and 30 cm H₂O. (5) When the external biliary bypass system was attached to the patients and the reservoir compressed almost every hour and a half, CBD pressure was usually kept negative with some exceptional positive pressure recordings which never exceeded jejunal pressure (Fig 3).

Clinically, the external biliary bypass with the bile pumping reservoir worked well. The longest survival after this bypass operation was achieved in Case 3, who lived for 12 months. This patient was followed as an outpatient for 9 months without any trouble until he was readmitted and died of peritonitis carcinomatosis. The other two patients died of cachexia 4 months after the application of this pump.

Obstructive jaundice did not recur except when cholangiography was performed or when the amount of bile production was so large that the frequency of pumping was not enough.

Patients could move freely and hospitalization was not necessary.

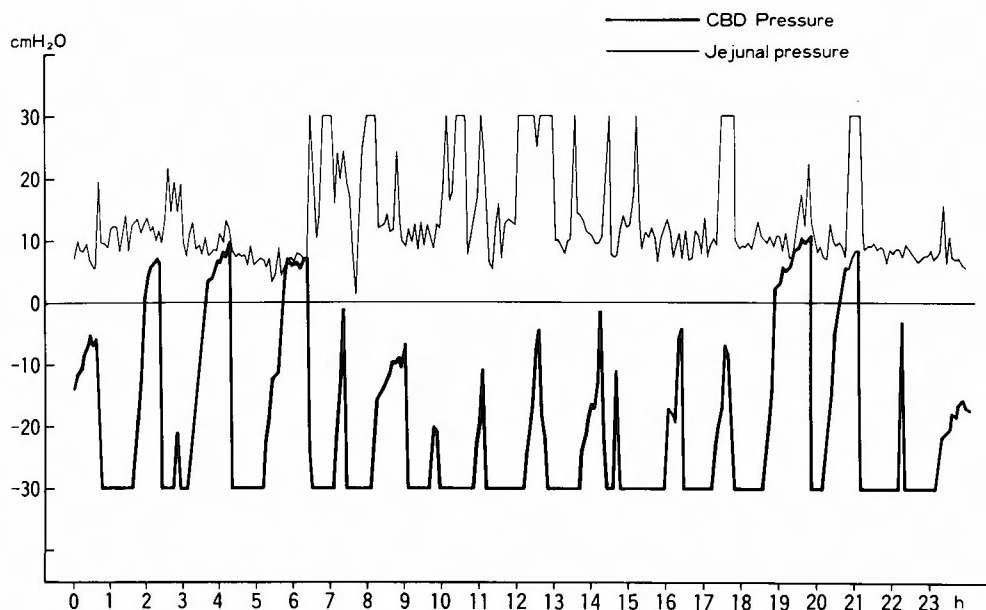


Fig. 3. Common bile duct pressure and jejunal pressure recorded simultaneously for 24 hours. Abrupt decrease of the common bile duct pressure corresponds to the negative pressure created by the reservoir when it is left to expand after bile in it is emptied into the jejunum by intermittent manual compression.

Comments

Fasting common bile duct pressure has been reported to be between 10 and 15 cm H₂O or 11–13 mm Hg, and resting duodenal pressure slightly below CBD pressure^(5, 11, 12, 14). Our 24 hour dynamic pressure monitoring showed that although CBD pressure should be maintained under 20 cm H₂O, a transient rise of CBD pressure does not result in the development of jaundice as long as biliary flow is kept constant as in the case of choledochoduodenostomy. This is also suggested by the known fact that internal drainage with PTCD can be effectively achieved with the tip of the PTCD tube either within the common bile duct or within the duodenum.

On the other hand, retarded bile flow with regurgitation of the intestinal contents results in retrograde cholangitis. In cases of congenital biliary atresia, direct biliointestinal anastomosis is not enough to prevent life-threatening cholangitis, and several methods have been devised to lower the incidence of cholangitis including an intestinal valve⁽¹⁵⁾.

With an external bypass between the bile duct and the jejunum, it is difficult to achieve smooth normograde bile flow with a long tube only, although jejunal pressure sometimes falls below CBD pressure. As a consequence a simple external connection between these two inevitably results in obstructive jaundice and retrograde cholangitis.

In order to resolve these problems an external biliary bypass system was designed. The one-way valve at the distal jejunal side prevents back flow from the jejunum into the reservoir and

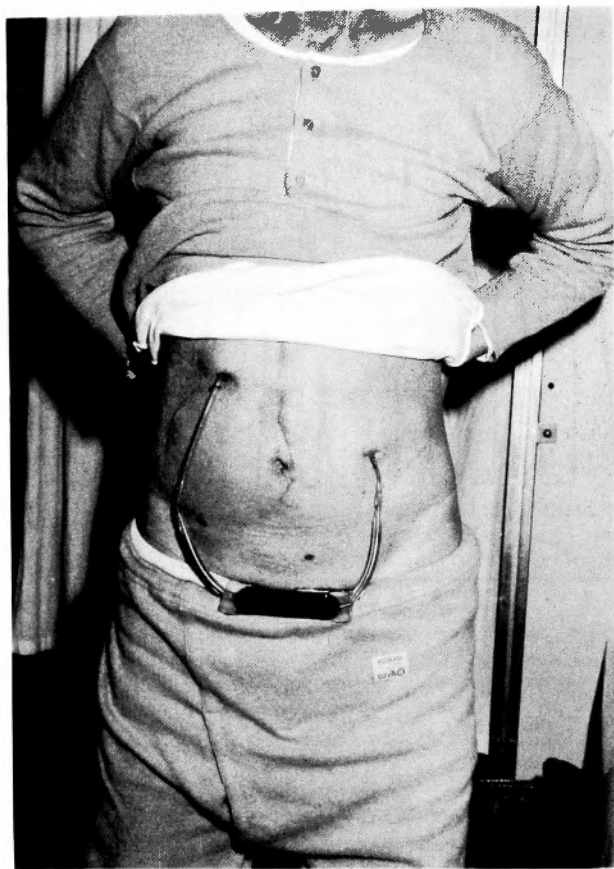


Fig. 4. External biliary bypass with bile pumping reservoir in place.

minimizes retrograde contamination. The reservoir itself is elastic so that manual compression forces bile from the reservoir into the jejunum, and during the intervals between two compressions bile is pumped into the reservoir from the proximal hepatic side with negative pressure. This negative pressure is within -70 cm H_2O and is well tolerated just as it is harmless to siphon from a patient lying in bed into a collecting bottle on the floor. The valve at the hepatic side blocks the pressure rise conducted proximally toward the bile duct when the reservoir is compressed, and hence reduces the chance of retrograde cholangitis. When manual compression of the reservoir is not done for a while, it fills with bile; however, minimal normograde flow of bile is not obstructed as the jejunal pressure sometimes falls below biliary pressure.

Patients with unresectable and/or inoperable extrahepatic malignant cholestasis and especially those for whom no effective internal drainage has been achieved can be treated with this method. General anesthesia is not necessary as in Case 1 and it can be applied to poor risk patients.

The whole system can be covered by ordinary clothing and patients are freed from the need for bile-collecting bottles, drinking bitter bile and a nasogastric tube (Fig 4). Bile

collected in a bottle, sometimes has a slightly rotten odor. With this closed system contamination is minor and there is no smell of bile.

With a reservoir of 20 ml capacity, patients are recommended to compress it almost every hour, since the amount of bile produced is about 500 ml a day. We think a larger reservoir would be better.

In about two weeks biliary sand forms within the system, so we change the reservoir every two weeks.

Summary

Unresectable malignant cholestasis for which no effective method of internal drainage could be achieved was treated with an external biliary bypass system including PTCD, a bile pumping reservoir and a catheter jejunostomy in three patients. All of them died with cachexia, one 12 months and two 4 months after insertion of the external biliary bypass. This method can be applied without general anesthesia and hence to poor risk patients. Effective drainage and return of bile into the intestinal tract was achieved. The patients were free to move and were able to lead more active and pleasant lives.

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和文抄録

胆汁ポンプを用いた体外胆汁バイパス

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切除及び内瘻化不能の悪性閉塞性黄疸 3 症例に対し，PTCD，胆汁ポンプ，及びカテーテル空腸瘻による胆汁の空腸還元を行った。

1 症例は12ヶ月後，他の 2 症例は 4 ヶ月後に癌死を免れなかったが，胆汁のドレナージは良好であった。

本手技は全身麻酔を必要とせず，プアーリスク症例に対しても施行可能である。

又，患者の体動は制限されず，身体的負担は軽減される。